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Remarks

Claims 1-9 are pending in the application.

Claims 1-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng et al. ("Receiver Optimization for 40-Gb/s Optical Duobinary Signal", IEEE Photonics Technology Letters, Vol. 13, No. 7, July 2001, page 744-746, hereinafter "Zheng") in view of Hayee et al. ("NRZ Versus RZ in 10-40-Gb/s Dispersion-Managed WDM Transmission Systems", IEEE Photonics Technology Letters, Vol. 11, No. 8, August 1999, page 991-993, hereinafter "Hayee"), and Lee et al. (US 2004/0101314, hereinafter "Lee").

Each of the various rejections and objections are overcome by amendments that are made to the specification, drawing, and/or claims, as well as, or in the alternative, by various arguments that are presented.

Entry of this Amendment is proper under 37 CFR § 1.116 since the amendment: (a) places the application in condition for allowance for the reasons discussed herein; (b) does not raise any new issue requiring further search and/or consideration since the amendments amplify issues previously discussed throughout prosecution; (c) satisfies a requirement of form asserted in the previous Office Action; (d) does not present any additional claims without canceling a corresponding number of finally rejected claims; or (e) places the application in better form for appeal, should an appeal be necessary. The amendment is necessary and was not earlier presented because it is made in response to arguments raised in the final rejection. Entry of the amendment is thus respectfully requested.

Any amendments to any claim for reasons other than as expressly recited herein as being for the purpose of distinguishing such claim from known prior art are not being made with an intent to change in any way the literal scope of such claims or the range of equivalents for such claims. They are being made simply to present language that is better in conformance with the form requirements of Title 35 of the United States Code or is simply clearer and easier to understand than the originally presented language. Any amendments to any claim expressly made in order to distinguish such claim from known prior art are being made only with an intent to change the literal scope of such claim in the most minimal way, i.e., to just avoid the prior art in a way that leaves the claim novel

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and not obvious in view of the cited prior art, and no equivalent of any subject matter remaining in the claim is intended to be surrendered.

Also, since a dependent claim inherently includes the recitations of the claim or chain of claims from which it depends, it is submitted that the scope and content of any dependent claims that have been herein rewritten in independent form is exactly the same as the scope and content of those claims prior to having been rewritten in independent form. That is, although by convention such rewritten claims are labeled herein as having been "amended," it is submitted that only the format, and not the content, of these claims has been changed. This is true whether a dependent claim has been rewritten to expressly include the limitations of those claims on which it formerly depended or whether an independent claim has been No. to include the limitations of claims that previously depended from it. Thus, by such No. no equivalent of any subject matter of the original dependent claim is intended to be surrendered. If the Examiner is of a different view, he is respectfully requested to so indicate.

Rejection Under 35 U.S.C. 103(a)

Claims 1-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheng in view of Hayee and Lee. Applicants respectfully disagree.

Zheng discloses a method of optimizing a receiver for a 40 Gb/s optical duobinary signal by optimizing an optical filter and an electrical filter to improve the sensitivity of the optical duobinary signal without degrading the dispersion tolerance (e.g., Abstract).

As stated in the Office Action, Zheng fails to disclose the use of RZ modulation in conjunction with duobinary signal.

Thus, the Office Action relied on Hayee and Lee for teaching RZ modulation and a RZ-duobinary transmitter. The Office Action further stated that it would have been obvious to combine the RZ-duobinary of Hayee and Lee with Zheng so that both nonlinearity tolerance and dispersion tolerance can be improved, along with reduced ASE noise.

Applicants respectfully submit that the motivation for such a combination is not founded on either Zheng, Hayee or conventional teaching, but rather, on impermissible

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hindsight based on Applicants' teaching. Furthermore, the combination of Zheng and Hayee's RZ modulation is contrary to the intended purpose of Zheng.

As stated above, the object of Zheng is to improve the sensitivity of the 40 Gb/s optical duobinary signal without degrading the dispersion tolerance (Zheng's Abstract). Zheng also states that "[t]he dispersion tolerance is the most important factor for the optical duobinary signal" (p.746, right column, first paragraph; emphasis added).

Hayee specifically teaches that dispersion is worse for RZ modulation than for NRZ modulation, and that "40-Gb/s systems favor the usage of NRZ because dispersion becomes the key limiting factor at 40 Gb/s" (see Hayee's Abstract).

Since the object of Zheng is to optimize a receiver for a 40 Gb/s NRZ optical duobinary signal, the teaching of Zheng and Hayee would not have motivated one skilled in the art to modify Zheng's optical duobinary signal from NRZ to that of RZ modulation, because doing so would degrade the dispersion tolerance, which is contrary to Zheng's intended purpose.

In fact, Applicants submit that both Zheng and Hayee actually teach away from modifying Zheng to provide RZ modulation.

Furthermore, even if Zheng were combined with Hayee and Lee to provide RZ-duobinary modulation, one skilled in the art would still not arrive at Applicants' claimed invention.

For example, Fig. 4 of Applicants' specification shows a plot of an optical signal-to-noise ratio (OSNR) required to maintain a constant bit-error-rate as a function of the optical filter bandwidth for both NRZ-duobinary (curve 41) and RZ-duobinary (curve 42) signals in a 10 Gb/s system.

Following Zheng's teaching of improving receiver sensitivity, one would simply conclude from curve 42 that the optimum filter bandwidth, i.e., corresponding to a minimum required OSNR (or highest receiver sensitivity), is about 27 GHz, which is almost 3 times the data bit rate. That is, one would not have selected a narrower bandwidth of about 10GHz, or 1 times the data bit rate, as in Applicants' invention, because as shown by curve 42, this narrower bandwidth would have required a higher OSNR, which corresponds to a lower receiver sensitivity.

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This finds further support in Hayee, which teaches on p.991 (right column), that the bandpass filter for RZ format is $4R$, where R is the bit rate. Such teaching of the bandwidth for RZ being several times that of the bit rate is indeed typical of conventional teaching.

Thus, Applicants' invention of using a bandwidth of 1 times the data bit rate for filtering RX-duobinary signal is simply not taught or suggested by prior art teaching.

Finally, the non-obvious nature of Applicants' invention finds additional support in a secondary reference cited in the Office Action, that of Lyubomirsky, "Experimental Demonstration of an Optimized RZ-Duobinary Transmission System", IEEE Photonics Tech. Lett., vol. 17, p.2757-2759 (2005), which specifically references a 2004 publication co-authored by the Applicants on this subject.

Recognizing that "the return-to-zero (RZ) pulse shape may also be interesting for duobinary systems due to an inherent tolerance of RZ formats to fiber nonlinearity induced impairments," Lyubomirsky nonetheless commented that "RZ-based systems typically suffer a greater dispersion penalty, thus negating a major advantage in employing a duobinary format" (Lyubomirsky, p.2757, left column, end of first paragraph). That is, Lyubomirsky clearly expressed skepticism regarding the advantage of combining RZ with duobinary format.

However, Lyubomirsky noted "[a]n interesting recent paper by Xie et al. compared the RZ and NRZ-duobinary formats, and found that narrow optical filtering at the receiver can greatly enhance the dispersion tolerance of RZ-duobinary, albeit at the expense of a significant back-to-back (B2B) penalty." A copy of the Xie et al. paper (co-authored by the Applicants), IEEE Photon. Tech. Lett., vol. 16, p. 2162-2164 (Sept. 2004), is attached as Exhibit A.

Thus, Lyubomirsky extended the RZ-duobinary approach, first reported by Applicants in 2004, to include optimization of both the transmitter low-pass filter and receiver optical filter bandwidth. As stated in Lyubomirsky, significant improvement of the RZ-duobinary dispersion tolerance was achieved by reducing the optical receiver bandwidth, thus confirming the effect observed by the Applicants (Lyubomirsky, p.2759, left column, second paragraph).

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The fact that Lyubomirsky, an expert in this technical field, conducted a similar study only after Applicants' work on this subject, is yet another indication of the non-obviousness of Applicants' claimed invention.

In summary, Applicants submit that the claimed invention is not obvious over the cited references. Furthermore, since Zheng and Hayee teach away from the use of RZ modulation in combination with Zheng's method (which seeks to optimize sensitivity without degrading dispersion), the alleged motivation to combine Zheng, Hayee and Lee is merely hindsight based on Applicants' specification.

As such, independent claim 1 is patentable over Zheng, Hayee and Lee.

Independent claims 3, 4, 6, 7 and 9 recite relevant limitations similar to those recited in independent claim 1 and, therefore, for at least the same reasons discussed above, Zheng, Hayee and Lee, alone or in any permissible combination, fail to teach or suggest Applicants' invention of claims 3, 4, 6, 7 and 9, as a whole.

Thus, independent claims 1, 3, 4, 6, 7 and 9 are allowable over Zheng, Hayee and Lee under 35 U.S.C. 103. Furthermore, since all of the dependent claims that depend from independent claims 1, 3, 4, 6, 7 and 9 include all the limitations of the respective independent claim from which they ultimately depend, each such dependent claim is also allowable over Zheng, Hayee and Lee under 35 U.S.C. 103.

Therefore, the Examiner's rejection should be withdrawn.

Secondary References

The secondary references made of record are noted. However, it is believed that the secondary references are no more pertinent to Applicants' disclosure than the primary references cited in the Office Action. Therefore, Applicants believe that a detailed discussion of the secondary references is not necessary for a full and complete response to this Office Action.

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Conclusion

It is respectfully submitted that the Office Action's rejections have been overcome and that this application is now in condition for allowance. Reconsideration and allowance are, therefore, respectfully solicited.

If, however, the Examiner still believes that there are unresolved issues, the Examiner is invited to call Eamon Wall at (732) 530-9404 so that arrangements may be made to discuss and resolve any such issues.

Respectfully submitted,

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